Space Weather Technical Forecast

Issued on Monday 27 January 2025 at 13:01 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of further isolated M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been at Moderate levels, with an isolated LDE M2.4 flare peaking at 27/0812UTC, the origin is probably around the east limb.

There are currently seven sunspot regions on the Earth-facing disc. AR3961 has now rotated off the southwestern limb. AR3971, a bipolar region approaching the northwest limb, is now the largest group but has shown a weakening trend in recent imagery. Remaining regions are small and magnetically simple, and either stable or showing some weakening.

A filament eruption in the southeast beginning around 26/1830 UTC and an additional one near S20E10 beginning around 27/0510 UTC released CMEs but modelling suggests they are not Earth-directed. No other Earth-directed CMEs have been seen in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE at L1, was at background levels, around 300 km/s. Density was below average becoming average later. The Interplanetary Magnetic Field was weak, but increased from 2Nt to 7nT, with the north-south component varying weakly between +7 and -2nT. The phi angle was negative (towards the Sun). Geomagnetic activity was Quiet (Kp0-1).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 was at background levels.

High energy electron flux (greater than 2MeV) at GOES16 was Moderate, with a diurnal peak of 940pfu seen at 26/1800 UTC. The associated 24-hour fluence persisted below the Active threshold, reaching 4.03e7 integrated pfu at 27/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate solar activity is expected with a chance of further isolated M-class flares, and a slight chance of X-class flares.

Solar Wind / Geomagnetic Activity: No new CMEs feature in the forecast. A previously forecast CME from 22 Jan may have arrived at Earth but solar wind parameters remain weak. A further CME associated with a filament eruption around midnight on the 26th may give a weak glancing blow

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late on day 2 (28 Jan) or early on day 3 (29 Jan), again this is low confidence with most of the CME expected to miss Earth. A small coronal hole has developed in the northwest quadrant of the disc, however any influence from this feature is likely to be limited if at all.

Quiet to Unsettled activity (Kp0-3) is generally expected through the forecast period, with a very slight chance of Active to G1/Minor Storm (Kp4-5) intervals late Day 2 (28 Jan) or early day 3 (29 Jan) should any glancing CMEs arrive.

Energetic Particles / Solar Radiation: There is a slight chance of enhancements exceeding the S1/Minor Radiation Storm threshold, should any larger flares occur from the western hemisphere.

GOES16 high energy electron flux is likely to show a gradual decline. The corresponding 24-hour fluence is expected to remain below the Active threshold on a declining trend.

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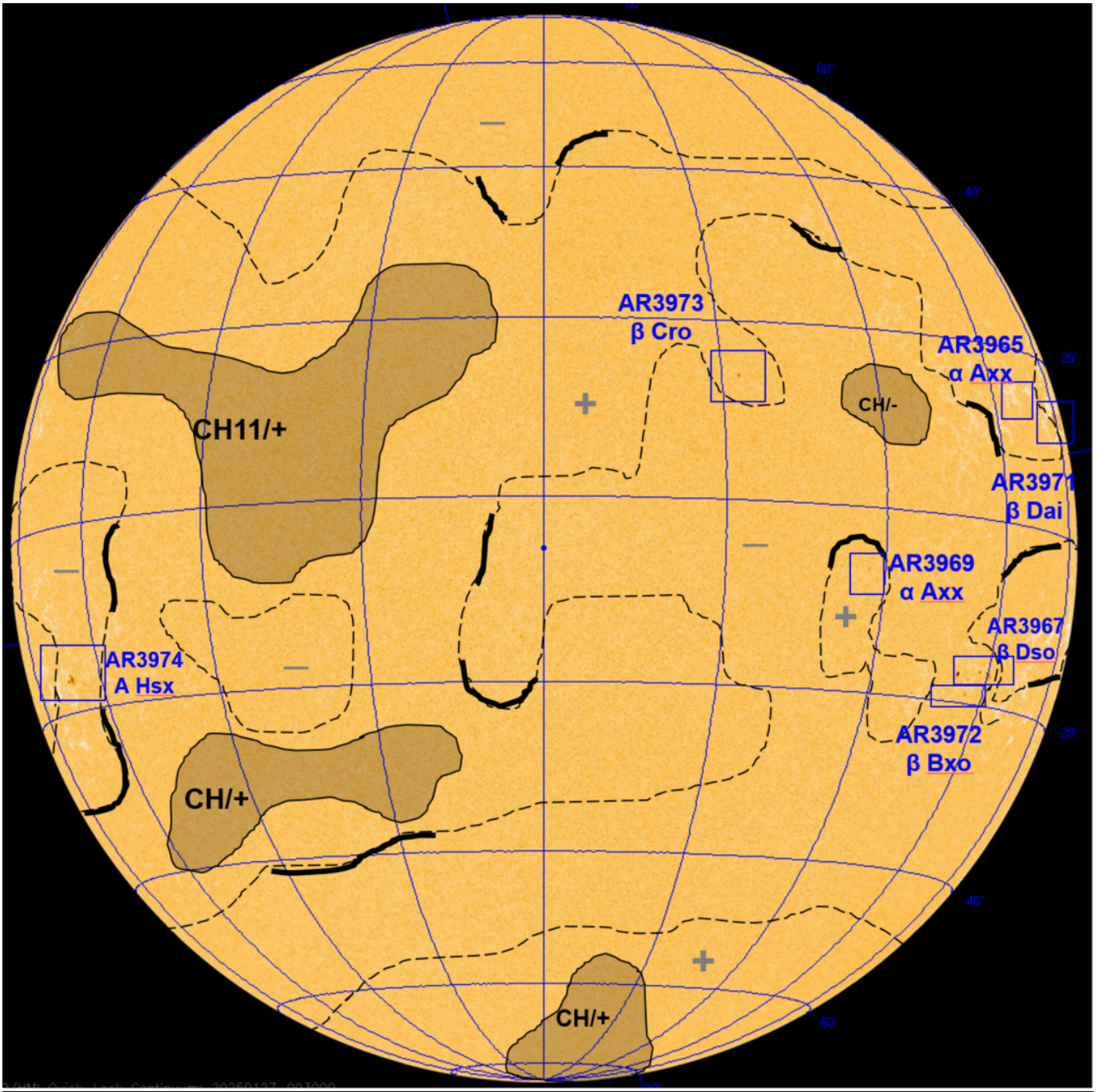
Figure 1: Solar Synoptic Analysis 27/0800UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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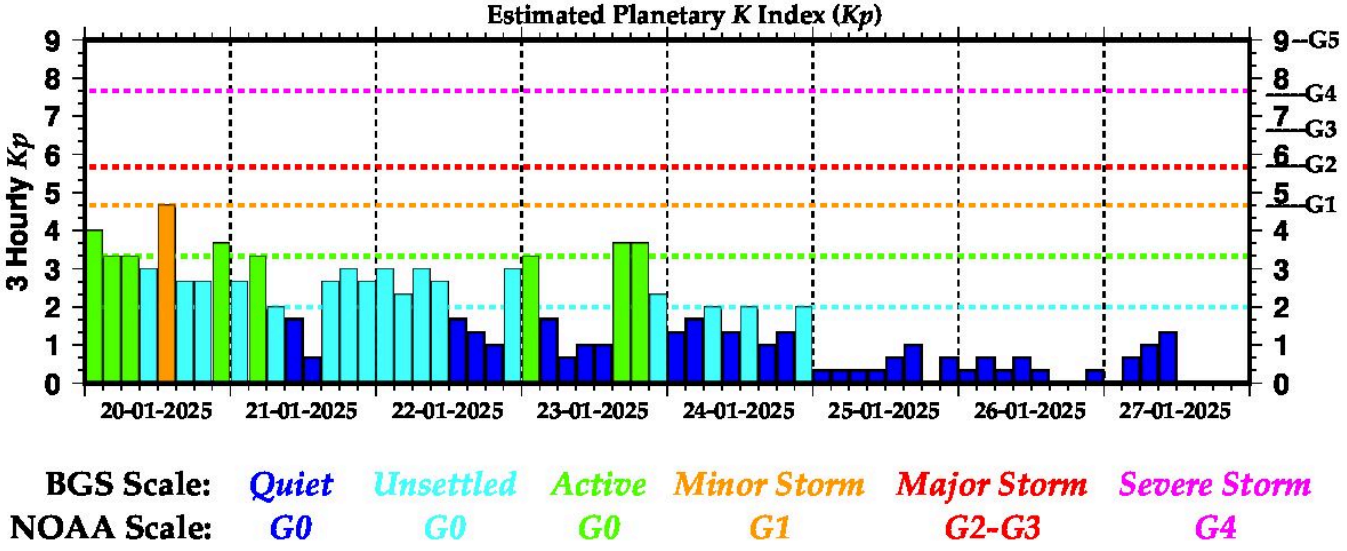
Geomagnetic Storms

No new CMEs feature in the forecast. A previously forecast CME from 22 Jan may have arrived at Earth but solar wind parameters remain weak. A further CME associated with a filament eruption around midnight on the 26th may give a weak glancing blow late on day 2 (28 Jan) or early on day 3 (29 Jan), this is low confidence with most of the CME expected to miss Earth. A small coronal hole has developed in the northwest quadrant of the disc, however any influence from this feature is likely to be limited if at all.

Quiet to Unsettled activity (Kp0-3) is generally expected through the forecast period, with a very slight chance of Active to G1/Minor Storm (Kp4-5) intervals late Day 2 (28 Jan) or early day 3 (29 Jan) should any glancing CMEs arrive.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Estimated planetary K index from BGS



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Radio Blackouts - X-Ray Flares

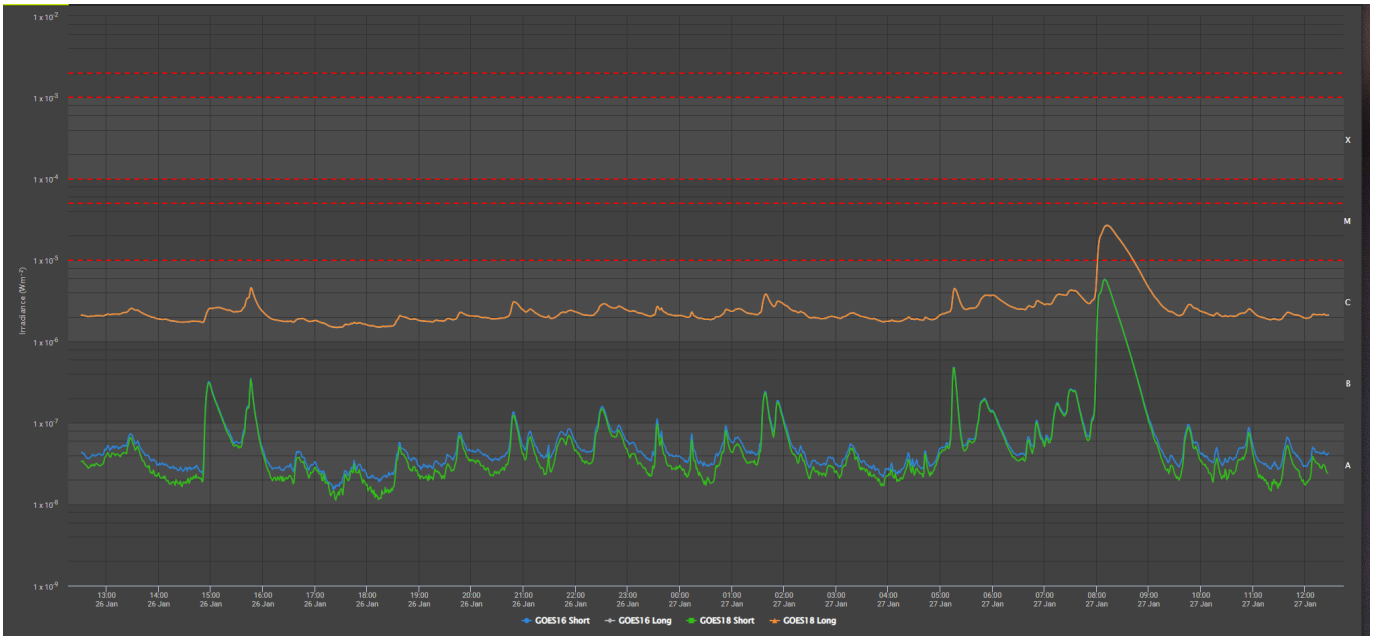
There are currently seven sunspot regions on the Earth-facing disc, with AR3961 and AR3962 rotating around the western limb and dropping out of the analysis. The largest group now visible on the disc is AR3971, a bipolar region approaching the northwest limb, although this has shown a weakening trend in recent imagery. AR3967, a small bipolar group in the southwest, has stabilised after recent growth of minor spots. Remaining regions are small and magnetically simple, and either stable or showing some weakening.

This means that trends in the coming four-day forecast period will rely on a balance between the departure of AR3961 and any east limb arrivals, with some suggestion of activity here given a series of CMEs emitted from over the east limb in recent days and the M flare from earlier which appears to have its origins just around the east limb.

Overall, the daily flare risk remains unchanged. Low to Moderate solar activity is expected with a chance of further isolated M-class flares and a slight chance of X-class flares.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	No	50	50	50	50
Very Active	R3-R5 (X Class)	No	10	10	10	10

Figure 3: GOES18 X-Ray flux



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Solar Radiation Storms (High Energy Protons)

Proton flux is currently at background levels, and is most likely to stay that way. However, there is a slight chance of it rising above the S1/Minor Radiation Storm threshold in the coming days, mainly due to AR3961 which is rotating over the western limb. This region will have rotated well away from the west limb by Day 3 (29 Jan) so this risk declines towards the end of the period.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	10	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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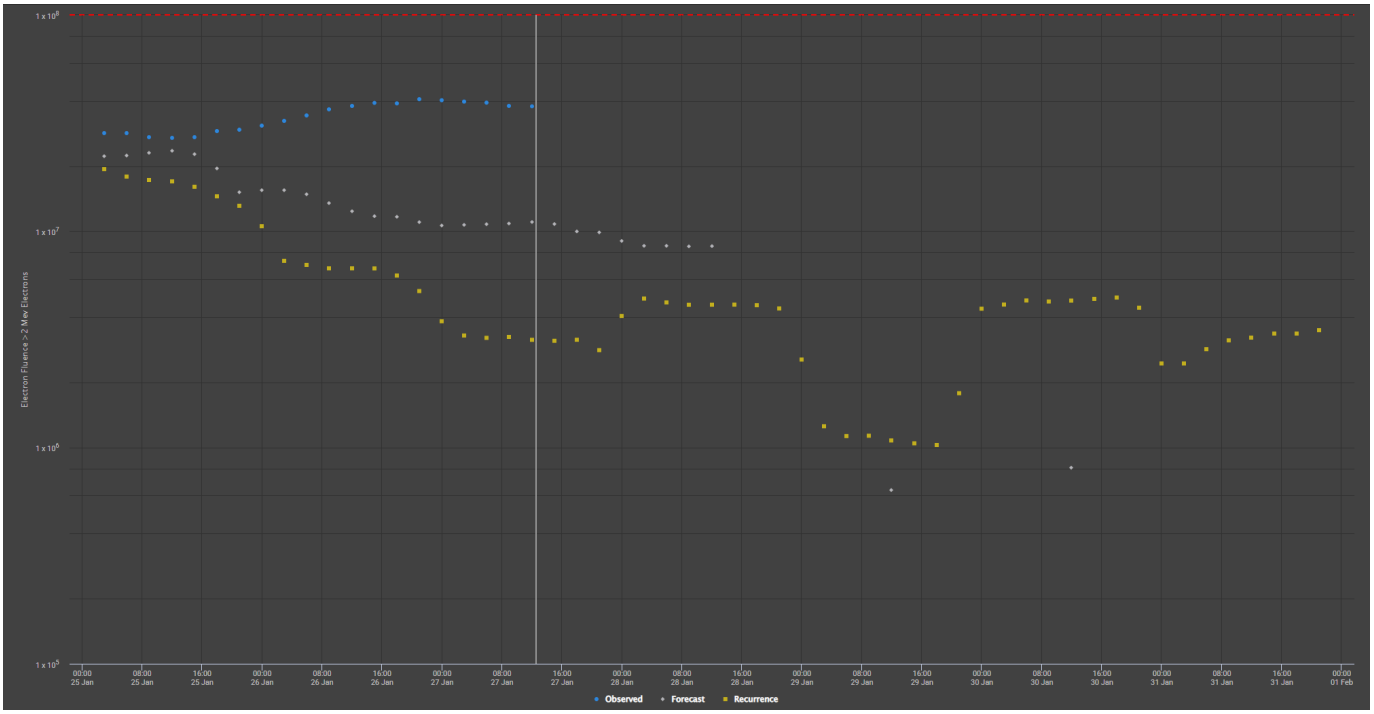
High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has been mostly at moderate levels in the last couple of days, after previous diurnally high peaks. This followed a connection to CH09/-, with this feature now lying over the western limb and wind speeds having returned to background levels. In the absence of further CME or HSS activity, a gradual decline in flux levels is forecast.

The corresponding 24-hour fluence is expected to remain below the Active threshold, with a gradual downward trend. MOSWOC REFM is felt to be giving reasonable guidance here, although clearly the forecast drop off has been faster than observed.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: MOSWOC REF Model



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